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Short report

Blood stain pattern interpretation in cases of fatal haemorrhage from ruptured varicose veins

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Abstract

Blood stain patterns from wounds are determined in part by the nature of the injuries, but also by the types of vessels that have been traumatised. Characteristic spray from arterial injury usually results in a fine projected bloodstain pattern, often found at some distance from the victim. In contrast, venous bleeding tends to be under much lower pressure and less disseminated. However, blood projected from ruptured varicose veins of the lower limbs may also result in a similar pattern of projected, disseminated fine bloodstains. Two cases of lethal haemorrhage from lower leg varicosities are presented involving a 60-year-old woman and an 86-year-old woman. Scene examination in both cases revealed evidence of extensive haemorrhage, with patterns of finely clustered bloodstains on the floors and walls produced by high venous pressures and the small wounds of the acutely ulcerated varicose veins. These features of ulcerated lower leg varicosities simulate the situation that occurs following arterial trauma, where blood may be forced out of a vessel under high pressure through a narrow defect. The fine, dispersed pattern of bloodstains in these cases reflected more the circumstances of the haemorrhage, rather than the intrinsic nature of the vessel of origin. An awareness of this phenomenon may assist in death scene examination when there is extensive haemorrhage with apparent arterial blood spray. An acutely ulcerated lower leg varicosity, with blood spray either on the floor, or at a level that corresponds to the height of the vascular injury, may indicate that the cause of the blood pattern was a lesion with higher than normal pressure venous, and not arterial, haemorrhage.

Keywords: Varicose vein; Haemorrhage; Death; Blood spatter pattern

1. Introduction

Varicose vein are a common condition in the community affecting up to 40% of individuals. [1,2] While complications of leg oedema, varicose eczema and ulceration, are not unusual, fatal haemorrhage from rupture is a rare event in most forensic practices. [3,4] It has been estimated that such deaths account for <0.01% of coronial cases. [5] The investigation of cases is usually straightforward, although the amount of blood at the scene, and the elderly and frail nature of many of the victims may raise the possibility of an assault.

Following a study of the characteristic pathophysiological features of fatal haemorrhage from lower limb varicose veins, a case was identified where unusual scene bloodstains were noted. [5] A search of the autopsy files at Forensic Science SA was undertaken and a further fatality was found with similar scene features. These cases are now reported to demonstrate additional problems that may arise in the interpretation of bloodstain patterns at death scenes due to the unique situation of lower limb varicosities.

2. Case details

Case 1: A 60-year-old woman was found deceased in bed at her home address with blood staining of her right shin

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and foot, and pooling of blood at the foot of the bed. Examination of the rest of the house revealed blood staining of the bedroom carpet and the bathroom floor, with a pattern of fine elliptical bloodstains around blood pools on the floor and also around blood stains on the lower walls and a wardrobe door (Fig. 1). The pattern and distribution of bloodstains was characteristic of the release of blood under pressure, as in arterial haemorrhage.

At autopsy an acute 2 mm ulcer was present anterior to the right lateral malleolus associated with haemorrhage (Fig. 2). No other injuries were present. Dissection of the ulcer revealed communication with a superficial varicosity that drained into the saphenous vein (Fig. 3). There was no arterial communication. There was varicose eczema of the surrounding skin. The only other significant finding was of marked coronary artery atherosclerosis. Death was attributed to exsanguination from a ruptured varicose vein of the right lower leg, with underlying severe coronary artery atherosclerosis.

Case 2: An 86-year-old woman was found dead at her home address with blood adherent to her right lower leg and extensive pooling of blood on the floor of the bath-

Fig. 1. (a, b) Collections of fine bloodstains on the floor and walls of the home of a 60-year-old woman who exsanguinated from an ulcerated lower leg varicosity. Prominent blood spray had stained the lower walls in keeping with an origin from the right ankle.

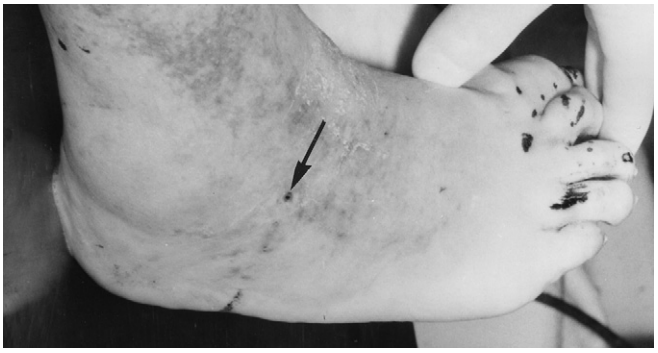

Fig. 2. Once the right leg had been cleaned of adherent blood the source of the haemorrhage was identified as a 2 mm ulcer involving a superficial varicosity near the right ankle.

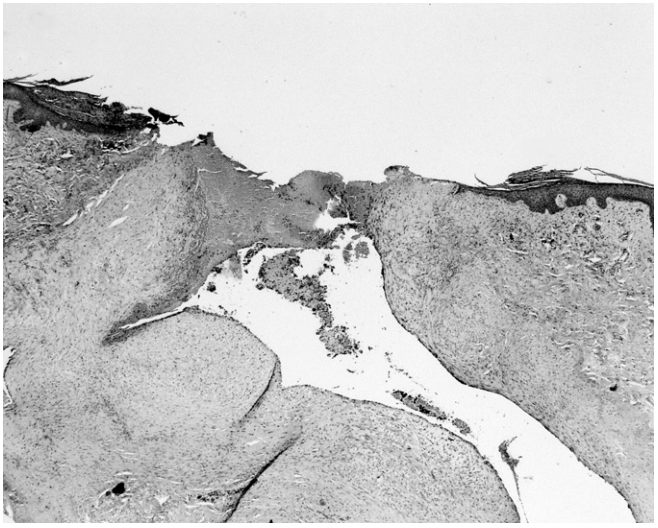

Fig. 3. Microscopic section of the ulcer and underlying varicosity in case 1 demonstrating a direct communication (Haematoxyllin & eosin, × 25).

Fig. 4. The floor of an 86-year-old woman's house showing blood stained footprints of the carpet and a pattern of fine bloodstains. Death was due to exsanguination from an ulcerated lower leg varicosity.

Fig. 5. A door in the house shown in Fig. 3 with further fine projected, 'arterial-type' bloodstain.

room. A fine blood spray pattern was present on the floor and lower part of the bathroom door, and along walls at a height corresponding to a lesion of the right leg (Figs. 4 and 5). The pattern of fine droplets was again characteristic of a projected pattern caused by the release of blood under pressure, as with arterial haemorrhage.

At autopsy an acute 3 mm ulcer was present on the lateral aspect of the right lower calf overlying a superficial varicosity. No other significant injuries were present and there were no areas of arterial trauma. The only other significant finding was superficial erosive gastritis suggestive of hypothermia. Death was attributed to exsanguination from a ruptured varicose vein of the right lower leg, with associated hypothermia. (This case was included in an analysis of the clinicopathological characteristics of fatalities due to ruptured varicose veins.) [5]

3. Discussion

Varicose veins are tortuous dilated vessels that arise in a variety of characteristic sites: in the lower limbs, in the lower oesophagus in cases of cirrhosis with portal hypertension, and around the anus with haemorrhoids. The aetiology of leg varicosities is uncertain with proposals that there may be intrinsic defects in the veins with weakness of the walls predisposing to valvular incompetence and blood pooling. Additional factors that may contribute to their development include prolonged standing, and major vein obstruction from obesity, ascites, pregnancy or intra-abdominal tumours. Deep venous thromboses may also increase venous pressure due to obstruction. [6,7]

The results of chronic pooling of blood in the veins of the legs are interstitial oedema, pigmentation and eczema, and ulceration. [2] Haemorrhage may occur if there is compromise of the integrity of the vein and its overlying tissues. This may occur because of trauma with skin and soft tissue laceration, or from chronic ulceration with erosion into a superficial varicosity. On occasion the rupture is acute and small (<5 mm), as in both of the reported cases. An autopsy approach to such cases has been previously reported. [5]

Bloodstain pattern analysis and interpretation are a standard part of many crime scene investigations, and examination of the characteristics of bloodstains may provide important information about the events leading up to their deposition. It has been stated that the distribution, shape, quantity and volume of bloodstains, and their relationship to the surrounding scene, provide investigators with a 'window to the past'. [8] The information able to be deduced from bloodstains may include the possible origin of the blood and the mechanisms that led to its deposition. Additional information may sometimes be inferred about the nature and sequence of the injuries, as well as the type of vessel that was damaged e.g. arterial or venous.

Classically, arterial bleeding is associated with a projected bloodstain pattern with significant volume and spines (the pointed edges that radiate out from the center of stains due to the volume and force of the haemorrhage). [8] Clusters of large elliptical stains and drip patterns occur with significant lacerations or incisions of large arteries causing an arterial spurt or gush that differs from impact spatters or low-velocity, free-falling droplets of blood. [9] Lesser injuries to smaller arteries may produce a much finer pattern from smaller droplets. As blood that escapes from veins is under much lower pressure it tends to pool until gravitational forces acting on it exceed the surface tension of the blood. This results in the formation of spherical droplets in free-fall that produce approximately circular stains upon impact with a horizontal surface such as a floor. These stains are characterised by their large size (13–21.5 mm) and their lack of directional indicators. [9]

In the two reported cases, aggregates of fine bloodstains were seen on the floors and lower walls of the victim's houses. These had the characteristics of projected bloodstain patterns associated with arterial injuries. However, autopsy examination revealed no arterial damage, with the only bleeding points being very small acutely ulcerated lower leg varicosities. Thus, these cases demonstrate an alternate cause of finely clustered projected bloodstains to arterial haemorrhage, high venous pressures with small exit orifices in acutely ulcerated varicose veins. This combination of factors in lower leg varicosities simulates the situation that occurs with punctured arteries or arterioles, where blood is forced out in a similar fashion under high pressure through a narrow defect. Thus the pattern of blood spatter reflects more the circumstances of the haemorrhage, rather than the intrinsic nature of the traumatised vessel.

In conclusion, the unique situation of lower limb varicose veins, with incompetent valves and pooled venous blood under higher than normal pressure, may result in fine 'arterial-type' blood spatter if a small defect occurs in the wall of a varicosity. An awareness of this possibility may assist in the evaluation of death scenes where there is extensive haemorrhage with apparent arterial blood spray. The identification of an acutely ulcerated lower leg varicosity beneath adherent blood clot, with blood spatter either on

the floor, or at a level that corresponds to the height above the floor of the vascular defect, are all features that support higher than normal pressure venous, and not arterial, haemorrhage.

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